The Pearson-Readhead Survey from Space

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We are using the VSOP mission to observe a complete sample of Pearson-Readhead survey sources at 4.8 GHz to determine core brightness temperatures and pc-scale jet properties. The Pearson-Readhead sample has been used for extensive ground-based VLBI survey studies, and is ideal for a VSOP survey because the sources are strong, the VSOP u-v coverages are especially good above +35 degrees declination, and multi-epoch ground-based VLBI data and other existing supporting data exceed that of any other sample. To date we have imaged 27 of the 31 objects in our sample. In addition, we are obtaining matched-resolution 15 GHz observations using the VLBA at epochs close in time to the space VLBI observations to investigate the spectral indices of the source components at high resolution. Our preliminary results show that the majority of objects contain strong core components that remain unresolved on baselines of ~30,000 km. The brightness temperatures of several cores significantly exceed 10^{12} K, which is indicative of highly relativistically beamed emission. We discuss correlations with several other beaming indicators, such as variability and spectral index, that support this scenario.

We gratefully acknowledge the VSOP project, which is led by the Japanese Institute of Space and Astronautical Science in cooperation with many organizations and radio telescopes around the world. This research was performed in part at the Jet Propulsion Laboratory, California Institute of Technology, under contract to NASA.

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Overview of observations

- Observing 31 of the Pearson-Readhead AGNs at 4.8 GHz with space VLBI
  - these were chosen on the basis of sufficient flux on long Earth baselines
  - 27 sources observed thus far.

- Determining core brightness temperatures and parsec-scale jet properties.

- Also obtaining VLBA observations of the sample:
  - matched-resolution 15 GHz observations
  - 43 GHz polarization observations

- The space VLBI images are of high quality and reveal more structural detail than do ground-based images at the same frequency.

The Pearson-Readhead Sample

- Selection criteria:
  - declination $> +35°$
  - galactic latitude $|b| > 10°$
  - total flux density at 5 GHz > 1.3 Jy

- Sample is ideal for a space VLBI survey:
  - sources are strong
  - high declinations are well-suited for VSOP
  - good existing databases: multi-epoch ground-based VLBI and others

Preliminary Results

- Most sources have strong cores that are unresolved even on the longest space baselines.

- Measured Gaussian component brightness temperatures are $>> 10^{11}$ K
  - values are lower limits only in many cases
  - implies these jets are highly relativistic, and pointed nearly directly at us.

- T_b is positively correlated with:
  - variability amplitude at 15 GHz
  - spectral index between 4.8 and 15 GHz
    - confirmation of relativistic beaming model.

Conclusions

- Space VLBI observations have revealed extremely compact cores in AGNs that remain unresolved even on $\sim 30,000$ km baselines.

- Inferred brightness temperatures above 10^{12} K imply very fast jet speeds and highly beamed emission.

- Many of the brightness temperature estimates are only lower limits.

- The brightness temperatures are correlated with variability amplitude and overall spectral index, in agreement with relativistic beaming model.

- Future space VLBI missions at higher frequency and/or orbital heights will be needed to further investigate the nuclear regions of AGNs.

- Pearson-Readhead Image Gallery:
  $\rightarrow$ http://sgra.jpl.nasa.gov/html_tingay/PR_images/